EDGE-PROVIDED TOOL AND METHOD FOR THE MANUFACTURE THEREOF

Scraper or cleaning blades denominated "doctor blades" are widely used in the paper and pulp industry for different purposes, but in most cases they have the function of cleaning or scraping off material or left-overs from the surface of a rotary roller. Such doctor blades have, for instance, the purpose of detaching a paper web from a stiff drying cylinder by scraping the surface of the cylinder.

The paper pulp contains filler such as silicon dioxide, great particles and paper fibers that wear out the doctor blade, the wear being substantially evenly distributed along the edge, and wherein it holds that the rate of wear is greater than the rate of corrosion. Furthermore, the doctor blade is seen as an article of consumption having very short service life, usually considerably smaller than one day. In many cases, it is exchanged already after approximately 5 hours. Usually no regrinding of the doctor blade is carried out but it is discarded when consumed.

There are different principles in the paper mills for the use of doctor blades, with the same in general being worn-in initially for the formation of an edge. When the same has been formed, the wear is relatively even. The proper "in-situ"-grinding-in is assumed to have a quality-influencing effect on the manufactured paper. If the doctor blade is used in a later stage of the production process of paper, it influences the paper quality and the surface structure of the paper, and therefore it is seen as a very critical parameter. The doctor blades may be of different length and vary between about 1 and 10 m.

Thus, since a doctor blade is subjected to extensive wear, different techniques are used in order to extend the service life thereof, such as addition of wear-resistant material on the part of the blade that meets the cylinder. As an example of such a reinforcement of the top or edge surface of the blade, ceramic hard coatings are presently used as a practical solution to bring down the blade wear. Such ceramic coatings are usually applied to a doctor blade made by hardened and annealed carbon steel and may be applied by thermal spraying, such as plasma spraying or plasma depositing.

Examples of techniques to provide such wear-resistant coatings on cleaning or scraper blades of the type doctor blades (in English "doctor blade") are found in GB-A-978 988, GB-A-1 289 609 and GB-A-2 130 924. The entire known technique is aimed at the provision of a wear-resistant coating on the part of the blade that comes into contact with the surface of a rotary cylinder.

According to prior art, with the purpose of improving the properties of the edge-provided tool, service life and thereby influence the paper quality, thermal (warm) spraying with HVOF ("High Velocity Oxygen Fuel") is, among other things, used. The method gives sintering of the additive material and so-called diffusion binding at about 1000 °C. Problems with this coating method are cracks, pores, poor binding strength, adhesion problems, etc. Materials sprayed today are ceramics, such as Al_2O_3.

Against this background, it is an object of the present invention to be able to provide an edge-provided tool, such as a doctor blade, which tool has been provided with a coating having better adhesion than that of hitherto known tools. Simultaneously, deformations of the tool arising otherwise should be tried to be minimized, at the same time as desired fineness requirements and absence of scratches on the completed paper product should be possible to meet. Furthermore, the supply of energy or influence of heat on the base material made by the surface treatment should as far as possible be minimized.

An additional object of the present invention is to produce a scraper and/or cleaning blade of primarily doctor blade type, which possesses long service life and which in the paper manufacture imparts the paper a smooth and fine surface, free from scratches and other defects.

These and additional objects have in a surprising way succeeded to be attained by providing the tool with the features defined in the independent claims. Preferred embodiments of the present invention are defined in the dependent claims.

The invention will be closer described below in connection with the drawing figures, where

Figure 1 shows a perspective view of a doctor blade applied in direct connection to a roller so as to wiping off the paper pulp in the production of paper;

Figure 2 shows an explanatory sketch of an edge-treated doctor blade according to the present invention;

Figure 3 shows an explanatory sketch of a coated doctor blade edge according to the invention, seen from the side;

Figure 4 shows an explanatory sketch of a laser-impregnated doctor blade edge according to the invention, seen from the side; and

Figure 5 shows an explanatory sketch showing laser coating of a doctor blade according to the invention.

Thus, the present invention relates to an edge-provided tool as well as a method for the manufacture thereof. More closely defined, the invention relates to a type of tool that is called "doctor blade" and that is a wiping, scraper and/or cleaning tool used in, for instance, the manufacture of paper, in order to get a smooth and fine paper product free from scratches and other defects. Also tools that usually are called coater blades, and also general knives, are comprised in the present invention. However, with the purpose of facilitating the description of the invention, the subject of the invention will below be designated "doctor blade", in which concept also other denominations are intended to be comprised.

Thus, figure 1 shows a doctor blade 1, which abuts against a roller 2 and, for instance, scrapes away pulp from the same. As a preferred example of materials that have turned out to work well in order to coat the edge portion of the material by means of laser technique according to the invention, steel grades having a hardness of at least 450 HV have been selected. An example of such a steel is a carbon steel having a composition comprising (in % by weight) 0,8–1,2 % of C, preferably about 1 % of C, 0,20–0,35 % of Si, 0,35–0,50 % of Mn, maximum 0,02 % of P, maximum 0,01 % of S, with Fe as balance and the content of some additional element in the periodic system in contents below 0,5 %.

Figures 2 and 3 show a steel strip 3, which on the edge thereof has been coated with a coating 4 by laser technique in accordance with the invention. Thereby, the resistance to wear is increased considerably. The coating is composed of, for instance, aluminum oxide or stellite (for instance stellite 12). The laser technique is, per se, well known to a person skilled in the art and is visualized in Figure 5. In the laser coating, the atomic (also called "metallurgical") binding to the steel substrate characteristic of the invention is attained, which is visualized in Figure 3.

Figure 4 shows a doctor blade in cross-section, which has been coated with, for instance, TiC in accordance with the present invention. The laser impregnation technique is described in the patent WO 99/56906. The steel strip is designated 5 and the impregnation applied by means of laser technique is designated 6. Also in this figure it is visualized that the particles/the carbides have penetrated into the steel substrate, whereby the limit between the two to a significant extent having been erased. The coating has been effected with, for instance, aluminum oxide or stellite, such as in the figures 2 and 3, while the impregnation is carried out with suitable carbides and/or nitrides.

According to Figure 5, the surface-reinforcing portion in the formed edge portion of a strip-shaped doctor blade is provided in the way that, by means of laser technique, a

coating, supplied by means of powder material 7, is applied to the edge under such supply of heat that the powder is fused with the basic material in the doctor blade, so that atomic and metallurgical binding arise. The supply of heat takes place by means of a laser gun 8, a coating 9 being provided on the substrate. The supplied material in the flow of powder 7 suitably consists of a refractory material, such as aluminum oxide. Alternatively, a material such as stellite may be used. In connection with the coating 9 having been applied to the doctor blade, it is important that the material can undergo a quick cooling, so that a desired fine structure is obtained, which is characterized by both toughness and hardness, more closely defined to a level of hardness corresponding to 850–1300 HV. In this way, simultaneously high bearing strength in the surface layer is attained at the same time as requirements of low friction and desired corrosion resistance can be fulfilled.

As has been mentioned above, the coating may essentially be composed of aluminum oxide or stellite. However, the coating may also contain or be composed of other refractory materials, such as metallic oxides, metallic silicates, metallic carbides, metallic borides, metallic nitrides and mixtures thereof. Especially preferred ceramic materials are selected among aluminum oxide, chromic oxide, zirconium oxide, wolfram carbide, chromium carbide, zirconium carbide, tantalum carbide, titanium carbide, titanium nitride, niobium carbide and borides.

As has been mentioned above, a laser impregnation may also be carried out by, for instance, carbides and nitrides such as TiC, NbC and TiN being added to the surface of the base material during the laser treatment. The particles are added by spraying under high gas pressure at the same time as the laser beam locally melts the surface layer on the material so that the wear-resistant particles can penetrate into the substrate. Furthermore, the laser coating may be effected in a plurality of rounds, so that multiple layers are obtained. The steel strip then receives a very wear-resistant surface.

The thickness of the steel strip is the normal one for doctor blades in the paper industry and may vary between 0,2 and 3 mm, suitably between 0,305 and 1,27 mm. The thickness of the coating or the impregnation may suitably be between 5 and 15 % of the thickness of the steel strip.